CLAIMS

What is claimed is:

1. A method to encode multiple video outputs from a common input video source, the method comprising:

temporally sub-sampling video frames of the common input video source to reduce a frame rate;

converting a color format of the video frames from a first format to a second format;

performing full motion estimation on a first sequence of video frames and generating motion estimation data to substantially match blocks of pixels from one video frame to another video frame in the first sequence;

generating a first video output using the generated motion estimation data;

reusing the generated motion estimation data to perform partial motion on at least a second sequence of video frames to substantially match blocks of pixels from one video frame to another video frame in the second sequence and modifying the generated motion estimation data to correspond to blocks of pixels in the second sequence that match; and

generating a second video output using the modified motion estimation data.

2. The method of claim 1 wherein generating the motion estimation data includes generating a motion vector indicative of a location of blocks of pixels in a current frame relative to a previous frame.

3. The method of claim 1 wherein temporally sub-sampling the video frames includes temporally sub-sampling the video frames once to a frame rate that is common to all video outputs.

4. The method of claim 1 wherein temporally sub-sampling the video frames includes temporally sub-sampling the video frames in a hierarchical manner, including progressively sub-sampling previously sub-sampled video frames to lower frame rates, with each frame rate corresponding to a different video output.

5. The method of claim 1 wherein converting the color format of the video frames includes converting the color format once to a color format that is common to all video outputs.

6. The method of claim 1 wherein converting the color format of the video frames includes converting the color format in a hierarchical manner to multiple color formats, including progressively converting color formats of video frames having previously converted color formats, with each color format corresponding to a different video output.

7. The method of claim 1, further comprising determining producer and user relationships between encoder components with respect to motion estimation data.

8. The method of claim 1, further comprising performing hierarchical Human Visual System (HVS)-based pre-processing to filter high frequency information from the video frames and to generate sequences of video frames having different bit rates.

9. An article of manufacture, comprising:

a machine-readable medium having instructions stored thereon to cause a processor to encode multiple video outputs from common input video data, by:

determining data producer and data user relationships between encoder components;

directing output produced from a first encoder component to a second encoder component in a same first encoder;

directing the output produced from the first encoder component to another encoder component in a second encoder different from the first encoder; and

using the output from the first encoder component in the second encoder component and producing output from the second encoder that is modified from the output produced by the first encoder.

10. The article of manufacture of claim 9 wherein producing output from the first encoder component includes producing full motion estimation data, and wherein using the output from the first encoder component in the second encoder component includes using at least some of the produced motion estimation data to locate an approximate location of a block of pixels in a frame without performing full motion estimation.

11. The article of manufacture of claim 10 wherein the motion estimation data includes motion vector information.

12. The article of manufacture of claim 9 wherein the machine-readable medium further has instructions stored thereon to cause the processor to encode multiple video outputs from common input video data, by:

temporally sub-sampling video frames of the common input video source to reduce a frame rate;

converting a color format of the video frames from a first format to a second format; and

hierarchically Human Visual System (HVS)-based pre-processing the video frames to obtain different bit rates and to remove high frequency information from the video frames.

13. The article of manufacture of claim 12 wherein the machine-readable medium further has instructions stored thereon to cause the processor to encode multiple video outputs from common input video data, by adapting the hierarchical HVS-based pre-processing based on outputs from subsequent encoder component processing.

14. An apparatus to encode multiple video outputs from common input video data, the apparatus comprising:

a temporal sub-sampling component to temporally sub-sample video frames of the common input video data to a lower frame rate;

a color format conversion component to convert the video frames from a first format to a second format;

a hierarchical arrangement of encoder components wherein output data of at least some of the encoder components can be shared as input data to other encoder components of different encoders; and

a negotiation block to determine data producer and data user relationships between the encoder components and to control flow of the input and output data of the encoder components.

15. The apparatus of claim 14 wherein the hierarchical arrangement of encoder components includes:

a hierarchical arrangement of motion estimation units corresponding to different encoders;

wherein a first unit of the hierarchical arrangement can perform full motion estimation on a first sequence of video frames and generate motion estimation data to substantially match blocks of pixels from one video frame to another video frame in the first sequence; and

wherein a second unit of which can use the generated motion estimation data to perform partial motion on at least a second sequence of video frames to

substantially match blocks of pixels from one video frame to another video frame in the second sequence and modify the generated motion estimation data to correspond to blocks of pixels in the second sequence that match.

16. The apparatus of claim 15, further comprising a final encoder component for each of the encoders, the final encoder components including a motion compensation element to use modified motion estimation data produced by respective first and second motion estimation units to re-generate a video frame.

17. The apparatus of claim 14 wherein either one or both of the temporal sub-sampling and color format conversion components can perform their respective operations once for all of the multiple video outputs.

18. The apparatus of claim 14 wherein the hierarchical arrangement of encoder components include a hierarchical arrangement of Human Visual System (HVS)-based pre-processing filters to reduce high frequency information in video frames and to change bit rates of the video frames, wherein output from one of the HVS-based pre-processing filters of a first encoder can be used as input to another one of the HVS-based pre-processing filters of a second encoder.

19. The apparatus of claim 18 wherein the HVS-based pre-processing filters are adaptive in response to outputs of another encoder component in their same encoder.

20. A system for encoding multiple video outputs from common input video data, the system comprising:

a means for temporally sub-sampling video frames of the common input video to a lower frame rate;

a means for converting a color format of the video frames from a first format to a second format;

a means for hierarchically sharing data output from encoder components, wherein output data of at least some of the encoder components can be shared as input data to other encoder components of different encoders; and

a means for determining data producer and data user relationships between the encoder components and for determining flow of the input and output data of the encoder components.

21. The system of claim 20 wherein the means for hierarchically sharing data includes a means for sharing motion estimation data between different encoders.

22. The system of claim 20, further comprising:

a means for receiving the common video data;

a means for transcoding the common input video data, including the encoder components; and

a means for transmitting the multiple video outputs to terminal devices.

23. The system of claim 20 wherein the means for hierarchically sharing data includes a means for hierarchically Human Visual System (HVS)-based pre-processing video frames.

24. A system for encoding multiple video outputs from common input video data, the system comprising:

an input point at which to receive common input video data for a single encoding session;

an encoder having a hierarchical arrangement of encoder components, wherein output data of at least some of the encoder components can be shared as input data to other encoder components of different encoders;

a negotiation block to determine data producer and data user relationships between the encoder components and to control flow of the input and output data of the encoder components; and

a plurality of output points from the hierarchical arrangement of encoder components to output a corresponding plurality of output video that has been processed by the encoder components during the single encoding session.

25. The system of claim 24 wherein the hierarchical arrangement of encoder components includes a hierarchical arrangement of motion estimation and macroblock mode units.

26. The system of claim 24 wherein the common input video data comprises raw video data.

27. The system of claim 24 wherein the hierarchical arrangement of encoder components includes a hierarchical arrangement of human visual system (HVS)-based filters.

28. The system of claim 24 wherein the hierarchical arrangement of encoder components all comprise software components.